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Management strategies for delivering Information and Communication Technology (ICT) in English secondary schools

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## ABSTRACT

The effective delivery of Information and Communication Technology (ICT) in English secondary schools lies beyond the authority and scope of traditional concepts of departmental management. Secondary schools that assume that ICT can be implemented through traditional management roles and departmental organisational structures are unlikely to be effective as these are too restrictive (Owen, 1992).

Models of educational management provide useful standpoints that can be analysed to inform theorising that seeks to identify possible features of a successful management strategy for delivering ICT in English secondary schools. In this paper, analysis of the different models of educational management identified by Bush (1995), i.e., the formal, collegial, political, subjective, ambiguity and cultural models, is used to inform theorising and derive a management strategy for delivering ICT in English secondary schools. This strategy is broader and more firmly grounded in theory than earlier attempts to describe such a strategy, and there is evidence of its effectiveness in practice (Crawford, 2001b), however, more research is needed.

## INTRODUCTION

The effectiveness of the ways in which ICT is delivered in English secondary schools may be influenced by different approaches to educational management. Traditional departmental management roles and organisational structures are unlikely to be effective as these are too restrictive (Owen, 1992). Models of educational management provide useful perspectives that can be analysed to inform theorising in order to identify possible features of a successful implementation strategy for ICT. In this paper, the impact of different approaches to educational management on the delivery of ICT in secondary schools is analysed in relation to the formal, collegial, political, subjective, ambiguity and cultural models identified by Bush (1995), and an implementation strategy for ICT is derived.

## ICT IN SECONDARY SCHOOLS - WHOSE RESPONSIBILITY?

In most English secondary schools, teachers are responsible to heads of department (middle management) who are answerable to senior managers for the activities of their departments (Bush, 1995). In general, the head of the mathematics department, for example, will have stable expectations regarding the amount of time that will be allocated to teaching mathematics each week; will produce programmes of work that enable the statutory curriculum or external examination syllabuses to be covered within the time available; will be allocated modest but consistent funds each year for spending on resources for teaching and learning; will allocate responsibilities for teaching particular classes to the minority of the school staff who are specialist teachers of mathematics; and will generally, though not entirely, ignore such matters in other subject departments, assuming that they are the responsibility of the appropriate head of department. Is such a relatively closed model of the scope of middle management responsibilities available to the Head of ICT, or are there factors that should result in the greater involvement of senior management? Are the planning of the ICT curriculum, the provision of adequate ICT resources for teaching and learning, and the deployment and training of teaching staff more properly the responsibility of a secondary school's senior management than tasks for middle management?

Curriculum models for ICT in English secondary schools can be described as (Crawford, 1997):

- subject ICT (or discrete ICT), where ICT appears in the school timetable, and is treated as a discrete subject similar to Mathematics or English.
- cross curricular ICT, where ICT is delivered entirely through the medium of other subjects, and the subject of ICT does not appear in the school timetable.
- hybrids of discrete and cross curricular ICT, including the 'kick start' model (National Council for Educational Technology [NCET], 1995a) where, for example, ICT is taught as a discrete subject in Key Stage 3 and across the curriculum in Key Stage 4; and the 'skills core' model (NCET, 1995a) where ICT is taught as a discrete subject in around half of the timetabled time devoted to other foundation subjects, enriched by some cross curricular delivery.

More English secondary schools adopt the hybrid model than those delivering ICT entirely across the curriculum or as a discrete subject, for example, in year 11, 48% of secondary schools deliver ICT as a hybrid, 31% entirely across the curriculum; and 21% as a discrete subject (Department for Education and Employment [DfEE], 1998b). In 75% of secondary schools, substantial usage of ICT is reported in Design Technology; in 40%-50% in English, Mathematics and Science; in 30%-40% in Geography, History, Languages and Music; and in 20%-30% in Art and the Humanities. Little or no use is reported in RE and PE lessons (Department for Education and Skills [DfES], 2001). ICT is used on average between 13 lessons per week in year 7 and 22 lessons per week in year 12 (DfEE, 1998b). In addition, the deployment of ICT hardware and software is more often throughout the whole school rather than only within the ICT department. Consequently, pupils' experience of ICT is not limited to lessons delivered by a small number of ICT

specialist teachers working within an ICT department, and there is unlikely to be consistent curricular provision for ICT within or between schools. This contrasts markedly with the relative consistency of provision for well established subjects, such as Mathematics. This variability and diversity of provision is indicative of a general lack of consensus regarding appropriate aims and outcomes, and what must be done to achieve these. Perhaps as a result, only 'about half' the English secondary schools inspected by the Office for Standards in Education (Ofsted) met the statutory requirements of the National Curriculum (NC) orders for ICT, and 'the quality of curriculum planning for ICT and ... subject management ... are often unacceptably low' (Goldstein, 1997). ICT in secondary schools extends across traditional departmental boundaries, and, consequently, effective management of it is more appropriately the responsibility of senior management.

Funding for the provision of ICT resources is likely to be of particular concern because of its magnitude in relation to the total school budget for teaching and learning resources. As there is unlikely to be ample finance, decisions will be made that prioritise spending, and as a result, what can be done is determined. In general, it is senior management that decides, or at least has a very strong influence on, how funding received by the school is spent by the school, and consequently determines the various activities carried out by the school. Budget allocation and distribution affects the character of the school, and in particular, the standing given to ICT in the school (NCET, 1994). The average expenditure per secondary school pupil on ICT resources for teaching and learning was £54 (DfES, 2001). On average, there were 127.7 computers per school with 36.1% being over 3 years old; and an average of 7.1 pupils per computer (DfES, 2001). 41% are permanently located in an ICT room and 41% in a study area or classroom (DfEE, 1998b). These statistics are averages and, as such, mask much larger variations. It would seem that the budgetary decisions made by senior management affect the quantity and quality of the ICT resources available in a school.

Regular and adequate funding is necessary to ensure appropriate provision of ICT resources. Because of the rate of technological development, ICT hardware and software is generally considered obsolete after three to five years, and it has been calculated that around £30,000 per annum is needed by a secondary school with 850 pupils to ensure that its ICT resources continue to provide a satisfactory experience of ICT for pupils at the school (Crawford, 1997). This required expenditure is consistent with current averages. In 2001, the average expenditure per school on ICT resources for teaching and learning was £49,600 (DfES, 2001), and in 1998, on average, a rural secondary school spent £29,849 whilst a secondary school in an inner area of large town or city spent £35,963 (DfEE, 1998b). However, schools rarely budget for this level of spending on ICT resources each year, and the average expenditure reported includes very large exceptional payments to relatively few schools obtained under schemes such as the Technology Schools Initiative (TSI). Schools that have successfully bid for TSI funds often have exceptional pupil: computer ratios while other schools are poorly resourced. A reliance on bid based funding is not a satisfactory strategy for ensuring adequate provision in the long term. Whether or not sufficient funding is consistently available each year is the responsibility of senior management, and the recognition of this responsibility is the major factor in determining the adequacy and availability of ICT resources. This is recognised in the requirement that bids from Local Education Authorities (LEAs) to the Department for Education and Employment (DfEE) for National Grid for Learning (NGfL) funding, must include ICT development plans for the Local Education Authority (LEA) and each of its associated schools (Scratcherd, 1998).

Hybrid and cross curricular models of the ICT curriculum anticipate that all teaching staff, whatever their subject, will have the expertise to use ICT to support both the teaching and learning of their own subjects, and the development of pupils' ICT capability. In addition, the cross curricular model is also likely to require that teachers of subjects other than ICT assess pupils' ICT capability in relation to the NC ICT level descriptors. Whilst it is now mandatory for all new entrants to the teaching profession to satisfy the requirements of the NC for Initial Teacher Training (ITT) for the use of ICT in subject teaching (DfEE, 1998a, Annex B), the majority of serving teachers have not yet been trained to the required standard, and consequently, it is unlikely they will have the expertise to teach and assess ICT. In addition, whilst PGCE and BEd courses with a main subject specialism of ICT have been available since September 1996, very few serving ICT teachers have qualifications in ICT or a related subject. Never-the-less, 96% of secondary schools have ICT coordinators who are expected to implement ICT plans and policies; provide technical support and train colleagues; and advise on ICT products (DfEE, 1998b). As a result of government demands that all teachers at least use ICT to support teaching and learning, and the general lack of ICT skills, knowledge and understanding in secondary schools, the magnitude of this particular teaching staff skills deficit is far greater than the capacity of traditional departmental structures to address it. Any ICT department with the capability to provide this training would inevitably be required to make decisions more properly determined at the level of senior management (Owen, 1992). Again, the scale of this problem is now recognised by government, and training for all serving teachers in the use of ICT in subjects has been made available, commencing in 1999 and financed by the New Opportunities Fund

(NOF).

The effective implementation of ICT in secondary schools clearly lies beyond the authority and capability of middle management. Hopkins (1992), although concerned with the effective management of ICT in Further Education or tertiary colleges, states that 'Principals and the whole college management have a duty to prepare their colleges for change on a significant scale.', and believes that without this commitment success is unlikely. Similarly, without the involvement of senior managers, it is unlikely that secondary schools will be successful. Schools that assume that ICT can be implemented through traditional models of departmental management will not make the best use of ICT throughout the school (Owen, 1992).

## THE IMPACT OF DIFFERENT APPROACHES TO EDUCATIONAL MANAGEMENT

There are considerable differences in the levels of provision for ICT and the ways in which it is implemented even between apparently similar secondary schools (DfEE, 1998b; Goldstein, 1997). Different approaches to educational management are likely to have some impact on this. In order to identify possible management strategies that will help secondary schools deliver ICT more effectively, the effects of these on the delivery of ICT are discussed below in relation to the formal, collegial, political, subjective, ambiguity and cultural models of educational management identified by Bush (1995).

Computer technology is essentially rational and systematic, so that ICT systems may be implemented most effectively by institutions with formal management structures. Descriptions of formal models of educational management identify many structural features similar to those of ICT systems. For example, they treat organisations as systems with '... units systematically related to each other ...'; which are represented by '... charts which show the authorised pattern of relationships ...'. The '... structures of the organisation tend to be hierarchical ...'. 'Having a purpose is inherent in the notion of the organisation.' and rational and logical means are used to pursue this. Power is positional and by virtue of the office held, and there is an emphasis on '...the accountability of the organisation ...' (Bush, 1995). ICT systems are entirely purposeful and task focused, and their construction can be represented by system flowcharts and diagrams which are hierarchical, logical representations of the ways in which the required modules or functions have been implemented. An ICT system is thoroughly tested before implementation to ensure that it meets performance specifications, that is, accountability is ensured. It may be that ICT systems can be more easily integrated with institutions that are formally organised because they will have explicit, logically similar structures that can be adjusted in clearly defined ways to further facilitate mutual compatibility.

It is likely that the most effective arrangement for implementing ICT will be a formal, hierarchically organised team led by a Headteacher with ICT expertise. 'If professional expertise is concentrated near the base of the bureaucratic pyramid the rules themselves must be largely a product of the consent of those to whom they apply.' (Williams et al, 1983, quoted in Bush, 1995). This generalised observation is a feature of all hierarchical organisational structures, and can be re-contextualised as: if expertise and enthusiasm for ICT are concentrated near the base of the formal management hierarchy, then its application throughout the school depends on the extent of its acceptance by individuals at this level. An ICT coordinator below senior management level in a formal, hierarchically organised school will lack sufficient authority and power to manage ICT effectively across the institution as whole whatever is achieved within a delimited departmental arena (Owen, 1992). The attitude of the Headteacher is the most important factor in influencing attitudes towards computers and ICT. If computers are ignored or merely accepted by the Headteacher, they will be marginalised within the school (NCET, 1994). The technical responsibility for implementation could be delegated, but even so, should be directed by a senior manager who understands the technical issues and can ensure that the arrangements are effective, and that overall school interests are taken into account (Hopkins, 1992).

Whilst the involvement of a senior manager may lead to the use of ICT throughout school, such an arrangement may not always lead to universal acceptance of the ways in which it is used. There may be '... disputes over objectives, and the definition of the 'problem' ...' (Bush, 1995), and as a result, the particular organisational and technical solutions selected by the institution may not be perceived as effective throughout it. Hierarchical institutions are more likely to design monolithic solutions that seek to achieve an outcome through a unique set of procedures rather than multiple processes that meet the needs of different groups within the school. For example, where schools seek to impose a uniform hardware platform, say, IBM compatible computers, teachers often express preferences for other, incompatible technology, say, Apple computers. At an institutional level, there are sound technical reasons for

choosing a uniform hardware platform, these are, transferability of skills; easier and cheaper maintenance; and bulk purchasing discounts, however, users may have valid reasons for preferring diversity, that is, familiarity and fitness for purpose. A school may prefer to supply the art department with IBM compatible computers but if these do not satisfy the needs of the art department as effectively as Apple computers then this is likely to lead to dissension and low utilisation.

Managing the delivery of ICT in its entirety requires considerable technical expertise. If senior managers do not have sufficient ICT expertise, then the formal model is likely to be much less effective. A flatter, collegial management structure where power and decision making are more widely shared may well be more effective than an hierarchical formal model. Professional experience supports this view: '... schools with open and flat-topped management structures are the ones most likely to have a good quality of well planned ICT resources. ICT invites collaboration and communication and so Headteachers who like to control everything directly don't, in the main, like ICT' (Seviour, 1998).

Problem solving through collaborative processes is likely to result in improved delivery at both institutional and classroom level. In English secondary schools, there is a general lack of ICT skills, knowledge and understanding, in breadth and in depth. However, ICT is considered to be of general usefulness in teaching and learning in all subjects and in supporting other professional activities (DfEE, 1998a, Annex B). In such circumstances, teachers with advanced ICT skills may impose a tyranny of expertise within their narrow sphere of influence. However, even those individuals with advanced ICT skills are unlikely to have expertise that is entirely comprehensive, and they may seek collaborative arrangements for mutual support with other professionals. Collegial management provides opportunities for teachers to participate more fully, and 'the quality of decision making is likely to be better' (Bush, 1995). Collegial models are characterised by: collective decision making through consensus where differences are overcome through rational argument; individual autonomy grounded in the 'authority of expertise' that arises directly from the exercise of professional knowledge and skills; shared values; and small decision making groups (Bush, 1995). The sharing of professional expertise can provide opportunities for self development and intellectual growth, and 'Effective implementation is much more likely if teachers feel that they 'own' the decisions ...' (Bush, 1995). Implementation may well be driven by a small group of teachers with advanced ICT skills, however, if success depends on wider understanding and acceptance by colleagues, then their multiple perspectives should be taken into account. In addition, teachers involved in delivering ICT will be more committed to it; will develop a wider range of ICT knowledge, skills and understanding; and will use ICT more effectively. The resulting implementation of ICT will be more flexible; will meet the needs of a wider variety of teachers and learners; and consequently, will be more widely accepted within the institution as a whole.

It is implicit in collegial management models that members of an organisation ultimately agree on its goals or find non conflicting solutions that satisfy a multiplicity of different needs. Unfortunately, this may not be possible. The example given earlier of the conflict between the institutional need for ease and economy of technical support, and the requirements of teachers with different subject specialisms, effectively illustrates this point. Such conflicts are likely to be more difficult to resolve where participants have equal status than in formal organisations where the needs of one group are likely to be subservient to those of the other. There is some doubt whether wholly collegial approaches to educational management are possible in practice (Bush, 1995). It may well be that the appointment of a senior manager with overall responsibility for ICT is desirable even in an ostensibly collegial organisation. This senior manager would have oversight of all decision making but the flatter structure more typical of collegial models would ensure that the different needs of ICT specialists and the whole staff are taken into account.

The process of determining consensus may be more extended in an institution with a collegial management organisation in comparison with the speed of decision making in a formal, hierarchically managed institution. Collegial management is likely to involve more elaborate systems of committees, and consequently, decision making can be ponderous and unwieldy, and may not keep pace with the rate of technological development. It is more likely that some of those involved will not fully understand the technical issues, so that the quality of decision making may be eroded. Moreover, where decisions emerge from a complex committee system, it may not be clear who is responsible for implementation. These features of collegial organisations may affect their ability to implement effectively new and rapidly developing technologies.

Formal and collegial models of the management of educational institutions assume that organisational structure is explicit and stable. In contrast, in a political model the organisational structure is understood as emerging from political manoeuvring and negotiation between competing groups as they pursue their own independent sectional interests. The provision of an adequate ICT curriculum, resources and staffing is one of many competing aims the achievement of which will conflict with the realisation of others' goals, and it is probable that this will be prioritised more highly and pursued more vigorously by ICT teachers.

The political model provides useful insights that are relevant to understanding how ICT is and can be promoted

within institutions. ICT coordinators may usefully seek to enhance their legitimate, positional authority and power through the development of their personal charisma; the possession of superior technical expertise; their restraint in communicating technical skills to others; and their control of the allocation of ICT resources. At an operational level, ICT coordinators often have considerable power over the distribution of hardware and software to other departments and individual teachers, and the availability of the technical support. Users are often very dependent on the ICT coordinator and other technical support staff who may be managed by the ICT coordinator, for access to ICT hardware and software, and support in using it. Without sufficient access and adequate technical support, users may not be able to make effective use of ICT resources for professional activities and in the classroom. ICT coordinators are able to reward those who are likely to be supportive by allocating more or better ICT resources to them; repairing hardware and maintaining software more promptly, and rationing training. There is limited research evidence that ICT coordinators and others employ such political strategies (Yeomans, 1995), and it is likely that some of these strategies might be considered unethical.

ICT coordinators often have more power within secondary schools than would normally be attached to their formal status. As the ICT coordinator's power derives from the needs of others, this power is significantly reduced where teachers do not want ICT resources or do not require the services or expertise of the ICT coordinator. Teachers may have good personal ICT skills or, in contrast, oppose or lack interest in using ICT in schools, and consequently have little dependency on the ICT coordinator, however, the need for the ICT coordinators' expertise is sustained by external pressures. The commercial development of new hardware and software quickly outdates teachers' ICT skills, and there have been a plethora of governmental initiatives from the early 1980s each with the intention of broadening the usage of ICT in schools. Current government targets for ICT in schools include: all serving teachers to be competent to use ICT in teaching their subjects by 2002; 75% of teachers and lecturers, and 50% of pupils and students to use their own email addresses by 2002; all schools to have an ICT development plan which should be made available during school inspections (DfEE, 1997). Other external pressures derive from schools' needs to access materials made available on the World Wide Web by the DfES, Teacher Training Agency [TTA] and other governmental agencies. Access is available to a variety of publications, for example, schools' Ofsted reports, and contact can be made with professional support networks. Such external pressures increase the demand for the ICT coordinator's services and skills, and as a result enhance their informal power.

Teachers with responsibility for ICT may well use political strategies to ensure that it is given sufficient prominence, however, this is unlikely to be effective in the long term. 'Political models assume that the goals of organisations are unstable, ambiguous and contested.' (Bush, 1995). The outcomes of the political process cannot be relied on to be consistent over time, so that whilst adequate finance for ICT resources may be ensured by political bargaining on one occasion, there will be no expectation of sufficient, reliable, annual funding. Without this, an adequate quantity and quality of ICT hardware and software is unlikely to be maintained because of the need for constant upgrading due to the rate of technological progress. Moreover, teachers' efforts will be concentrated on the successful outcome of bids for funding rather than on the integration and support of new and existing technologies. The provision of satisfactory ICT resources is more likely to be ensured by long term developmental planning, supported by the allocation of sufficient annual funding, than by political manoeuvring and negotiation leading to transient, short term solutions.

Political models provide explanations of the tensions between the competing goals of ICT teachers and those of other groups within secondary schools, and insights into the effects of the external pressures that seek to promote the use of ICT in schools. An understanding of the political process can help ICT coordinators enhance their formal power and their effectiveness. The descriptions and interpretations provided by political models can be useful in all institutions, even those that are explicitly managed using formal or collegial approaches, as to some extent political manoeuvring is inherent in all social activity, including management.

The rate and extent of an individual's adoption of new technology and assimilation of the associated changes in pedagogic practice are related to a variety of factors, such as, psychological predisposition to accept change, capacity to learn, and personal evaluation of the usefulness and desirability of ICT. Management strategies that do not take into account the different ways in which individuals value ICT and their motivations, will not lead to enthusiastic acceptance and effective implementation. Phenomenological, social interactionist and constructivist explanations of social reality (Mead, 1974; Richardson, 1997), that is subjective models, can provide insights into individuals' perceptions of organisations (Bush, 1995). Teachers experience secondary schools from different standpoints and interpret events in relation to their personal experiences and objectives, and this is important in relation to the extent of acceptance of ICT across the institution. The majority of teachers resent being required to teach ICT skills within their subjects (Williams, 1993). Rejection of ICT may be rational but is often recognisable as a simple psychological defence mechanism, for example, withdrawal or rationalisation (Burns, 1980).

Changing individuals' values and standpoints is likely to be a slow process and these may not always be adjusted in the ways intended (Bush, 1995). Teachers are encouraged to use ICT but the technology changes so rapidly that this

may discourage individuals tentatively engaged in personal evaluation and learning. For example, a teacher painstakingly learning to use a wordprocessor may learn using older hardware and software available at school, say, Word 6 on Windows 95. The teacher will discover in due course that the skills learnt have limited usefulness even at the time of learning as they have restricted transferability even to updated versions of the same software, for example, Word 2000 on Windows NT. Even if the teacher used the latest hardware and software, the rapidity of technological change may well overtake the teacher's rate of adaptation. This rapid skills obsolescence will be even more pronounced when using software which is not as standardised and well understood as wordprocessing software. As a result, teachers who are not ICT specialists may believe that the learning effort has been wasted rather than feeling empowered and enthused.

Whilst understanding individuals' values and perspectives may help senior managers motivate teachers, senior managers also have particular standpoints that are susceptible to change. As senior managers' goals are likely to have been integrated into those of the institution, changing their aims can lead to adjustments at an institutional level. Those lower down the organisational hierarchy may have their own goals and seek to change those of senior managers and the school through a process of 'upward management' (Somekh, 1997). This strategy may be particularly useful to ICT coordinators appointed at or below middle management level.

Ambiguity models of educational management assume that there is lack of agreement regarding institutional goals and purposes; that organisational processes, rules and structures are not entirely explicit or well understood; that organisations are characterised by fragmentation and loose coupling of decentralised sub groups; that individuals' powers and responsibilities are not clearly defined; that participation in decision making is inconsistent; and that the process of identifying problems and their solutions, and implementing, monitoring and evaluating these is not a linear, rational process (Bush, 1995). Secondary schools are believed to be examples of such anarchic organisation. Such chaos does not provide obvious organisational support for the implementation of whole school computer networks that are essentially monolithic, well structured and logical in nature, or curriculum policies that require the cooperation of all teachers and departments, however, ambiguity models may provide partial explanations of the difficulties inherent in delivering ICT in secondary schools. If such descriptions are accurate, then the implementation of ICT throughout the school can only be driven forward through the support of federations of individuals and interest groups with similar goals. In such circumstances, ICT coordinators are more likely to be successful if they can position ICT as a solution to a wide range of existing and potential problems for a wide range of individuals and interest groups.

The dominance of a set of shared values and meanings grounded in the professional experience of secondary school teachers is recognised by cultural models. These common understandings find expression as tradition and ritual, not only in the conduct of ceremonies, such as assemblies, but also in expected role behaviours. Cultural symbolism is expressed through language, patterns of social interaction, uniforms, etc., and the values, philosophy and ideology of the school are embodied in its heroes and heroines. For ICT to be adopted across the whole school then it must become part of the dominant culture. Its implementation may be led by heroes or heroines with particular charisma and ICT expertise, but for widespread adoption it must be seen to be an important part of organisational processes and procedures, and this must be reflected in its usage by senior management. The organisation must value its investment in ICT, and demonstrate pride in its achievements and long term commitment. In practice, as secondary schools begin to make effective use of ICT, symbolic gestures, such as putting a computer on the Headteacher's desk, and routinely showing visitors the new ICT resources, are common. These overtly demonstrate that the school values and takes a pride in its financial and intellectual investment in ICT.

## A DERIVED MANAGEMENT STRATEGY

Different approaches to educational management affect the delivery of ICT in English secondary schools. Models of educational management provide useful perspectives which have been analysed in order to synthesise and describe a management strategy that may lead to the effective delivery of ICT in English secondary schools. This derived management strategy is summarised below:

- The Headteacher or a senior manager with positive attitudes towards ICT should have overall responsibility for the management of the delivery of ICT throughout the school. This emphasises that successful implementation is important for the whole school.
- The senior manager in charge of the delivery of ICT should have good ICT skills, and an understanding of technical issues. This makes it more likely that the different needs of ICT specialist teachers and the whole staff



are taken into account.

- A formal, hierarchically organised management structure is preferable, but this should be relatively flat-topped. This ensures that it is clear who has overall responsibility; decisions can be made rapidly; and those teachers with expertise and interest are consulted. Consultation should be genuine and senior managers should be open to change.
- ICT coordinators should enhance their formal power through their personal charisma and technical expertise; by providing information; and by supporting colleagues' use of ICT.
- ICT coordinators should build coalitions among groups with similar interests in order to provide support for policy proposals.
- ICT coordinators should encourage colleagues to use ICT more widely for professional activities and to support teaching and learning, and should position ICT as a solution to a wide range of existing and potential problems.
- The different ways in which individual teachers value ICT and their motivations, should be taken into account, and there should be an awareness that changing these is likely to be a slow process which can be supported by the provision of up-to-date ICT resources.
- ICT should become a part of the traditions and rituals of the dominant school culture. It must be overtly demonstrated that the school values and takes a pride in its financial and intellectual investment in ICT.
- Acquisition of ICT resources should be funded by the allocation of sufficient annual funding in the context of long term developmental planning, so that teachers' efforts can concentrate on the integration and support of new and existing ICT resources rather than on the pursuit of one-off bids for financial support.

This derived management strategy is recognisable to the author who has substantial experience of ICT in English secondary schools as an ICT coordinator, a Chief Examiner for the General Certificate of Secondary Education (GCSE) in ICT, an author of textbooks for secondary schools, an Ofsted inspector, and a Senior Lecturer coordinating the initial training of ICT teachers. Earlier descriptions of management strategies for the delivery of ICT in English secondary schools can be found in the non statutory guidance (Department for Education and Science [DES] and National Curriculum Council [NCC], 1990b) accompanying the Technology NC orders (DES and NCC, 1990a), and advisory literature and research related to this (Crawford, 1997; Hackett and Kennedy, 1996; Owen, 1992). This advice is supportive of the derived strategy but narrower in scope.

Recent research shows that the adoption by a secondary school of a management strategy similar to the derived strategy is one of four factors associated with high levels of ICT capability in 14-16 year olds in English schools (Crawford, 2001b). However, this research investigated high levels of ICT capability in only four English secondary schools, and more extensive research into the effectiveness of the derived strategy is recommended.

## CONCLUSION

Secondary schools that assume that ICT can be implemented through traditional models of departmental management will not make the best use of it. The effective implementation of ICT in English secondary schools lies beyond the authority and scope of traditional departmental management. Analysis of the different models of educational management identified by Bush (1995), i.e., the formal, collegial, political, subjective, ambiguity and cultural models, has been used to inform theorising and derive a management strategy for delivering ICT in English secondary schools. This strategy is broader and more firmly grounded in theory than earlier attempts to describe such a strategy, and there is evidence of its effectiveness in practice (Crawford, 2001b), however, more research is needed.

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